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**CERTIFIED MAIL**
**RETURN RECEIPT REQUESTED**

September 10, 2014

Mr. Scott G. Mandirola, Director
Division of Water and Waste Management
Department of Environmental Protection
601 57th Street SE
Charleston, WV 25304-2345

**RE: Mt. Storm Power Station Order Number 6291: Outlet 001 Temperature Limits**

Enclosed is a paper that provides Dominion's proposed approach for application of West Virginia's temperature rise water quality criterion to discharges from Mt. Storm Lake (Outlet 001). The paper describes the substantial improvements that have been made to the Mt. Storm Lake management system. These improvements were designed and implemented with DEP oversight and approval and have resulted in a discharge from the dam that is compliant with the station's seasonal maximum discharge limits. Our proposed approach for application of the temperature rise criterion was developed with consideration for the operational capabilities of the new lake management technology. In addition, the paper also provides the basis for why our proposed approach is consistent with applicable law, regulations and guidance, and is fully protective of the underlying designated uses of the Stony River.

Dominion believes that our proposed approach provides a sound and practical method for application of the temperature rise criterion to the Mt. Storm Lake discharge.

Please feel free to contact Ken Roller at (804) 273-3494 or kenneth.roller@dom.com should you have any questions related to this submittal.

Sincerely,

Pamela Faggert

Pamela F. Faggert

Attachment

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cc: w/attachment

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**Environmental Program:** Water-NPDES
**Document Type:** Compliance Reporting and Supporting Documents

## Mount Storm Power Station:
## Proposed Temperature Limits for Mount Storm Lake Discharge

September 10, 2014

### INTRODUCTION

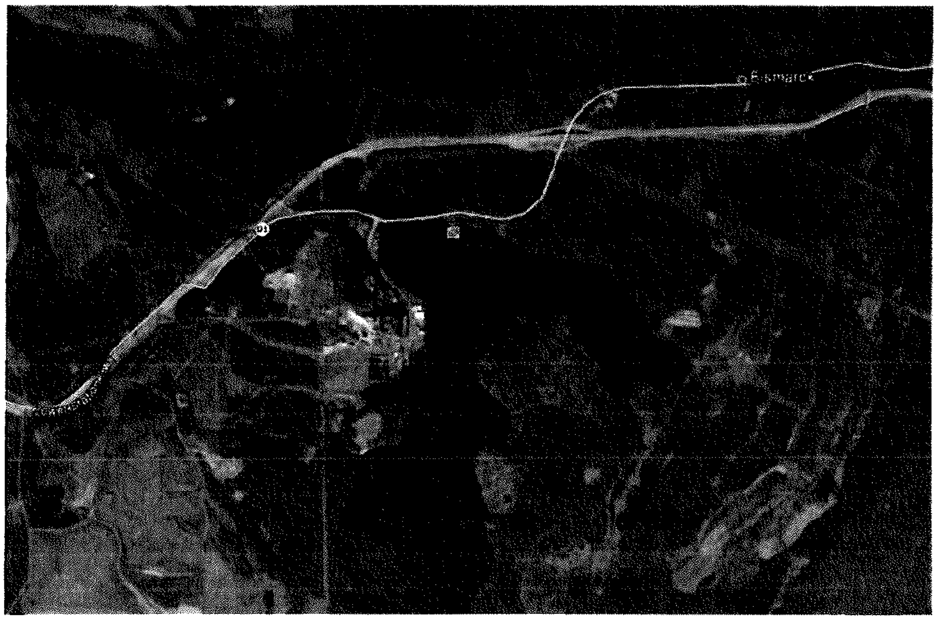
The Mount Storm Power Station is owned and operated by Virginia Electric and Power Company, doing business as Dominion. The station is an electricity-generating station located in the Stony River watershed in Grant County, West Virginia. This document describes actions by Dominion to comply with West Virginia's surface water quality criteria for temperature in the Stony River downstream from Mount Storm Lake. In particular, meeting water temperature standards, including a temperature rise limit, is necessary for issuance by the West Virginia Department of Environmental Protection (WVDEP) of a National Pollutant Discharge Elimination System (NPDES) permit under delegated authority from the U.S. Environmental Protection Agency (EPA).

Mount Storm Power Station burns coal for fuel to generate up to 1,632 megawatts of electricity. The Station withdraws water for condenser cooling from, and discharges the thermally enriched water to, Mount Storm Lake, an artificial reservoir that impounds a reach of the Stony River. The reservoir was constructed for the specific purpose of providing cooling water for the station. The station's location was selected to make use of locally mined coal for the coal-fired generating station. Construction of the station, including the dam for the cooling reservoir, began in 1961. The reservoir was completed in 1963. Units 1 and 2 of the station began operation in 1965 and 1966, respectively, and Unit 3 was put in service in 1973 (DEES 2005). The station is located on a peninsula near the dam (Figure 1). Cooling water for steam condensers is withdrawn from and discharged to Mount Storm Lake at locations near the station. The river flow downstream of the dam consists of local seepage and intermittent discharges from the lake.

The Stony River upstream and downstream of Mount Storm Lake has been substantially impacted by acid mine drainage (AMD) from previous mining activities. Since construction of the reservoir, Dominion has undertaken a number of voluntary efforts to mitigate the impact of AMD on Mount Storm Lake. Particularly, Dominion has introduced acid-neutralizing materials (lime) to the cooling-water discharge into the lake beginning in the mid 1970s (DEES 2005). Biological productivity of the lake and the river downstream has been sustained largely by the acid neutralization, as demonstrated by temporary cessation of liming in the late 1970s.

Regulation of the power station's discharges began in 1961 with the issuance of Permit No. 1128 from the West Virginia Department of Natural Resources, the WVDEP's antecedent agency (DEES 2005). Following enactment of the Federal Water Pollution Control Act Amendments of 1972 the station's discharge from the lake into the Stony River was first regulated for temperature in 1975.

**Figure 1:** Map of Mount Storm Lake, with Mount Storm Power station on the peninsula.



Regulation of the power station's discharges began in 1961 with the issuance of Permit No. 1128 from the West Virginia Department of Natural Resources, the WVDEP's antecedent agency (DEES 2005). Following enactment of the Federal Water Pollution Control Act Amendments of 1972 the station's discharge from the lake into the Stony River was first regulated for temperature in 1975.

On April 14, 2008 Dominion entered into Administrative Order No. 6291 (Administrative Order) with WVDEP requiring the installation of lake management technology to control thermal releases to Stony River in order to attain compliance with West Virginia's temperature water quality standards in the discharge from Mount Storm Lake. The Administrative Order also provided some opportunity for Dominion to make a future demonstration that, through implementation of the lake management controls and reintroduction of aquatic species, a balanced indigenous aquatic population (BIP) had been attained.

In accordance with the Administrative Order, Dominion has implemented, with WVDEP approval, numerous modifications to the lake management system that have enabled Dominion to control thermal releases to the Stony River in accordance with West Virginia's seasonal maximum temperature standards of 87° F May 1-November 30 and 73° F December 1-April 30. These modifications include a helper cooling tower system capable of lowering lake discharge temperatures, new spillway gates and valves, a discharge control system capable of controlling the release of water at the spillway, and a weir at the outlet of the spillway's stilling basin where temperature is monitored for compliance. In addition to seasonal maximum temperature criteria, West Virginia's temperature standards also include a provision that heat not be added to a stream in excess of the amount that will raise the temperature of the water more than 5°F above "natural". 47 CSR 2, Appendix E, Table 1, Standard 8.29. There are also narrative provisions in the standards that require the maintenance of normal daily and seasonal temperature fluctuations. Given the unique circumstances related to the discharge from the Mount Storm Power Station to the Stony River the most appropriate means of interpreting and implementing this provision in the NPDES permit for the Mount Storm Power Station requires careful consideration and is a main reason for preparing this document.

Following implementation of the lake management controls, Dominion undertook extensive efforts to reintroduce targeted species to the Stony River in order to establish an aquatic community consistent with that expected to reside in the Stony River below Mount Storm Lake. These efforts were conducted with agency approval and oversight and have resulted in substantial improvements to the biological composition of the Stony River below Mount Storm Lake as evidenced by the most recent biological studies (DEES 2014).

This document provides an overview of the work undertaken to comply with the lake management requirements of the Administrative Order and provides rationale that the resulting discharge to Stony River can comply with West Virginia's temperature water quality standards. In addition, this document sets forth Dominion's proposed approach to revising the temperature differential limit in the current NPDES permit for Mount Storm in light of these facts and the relevant legal considerations.

## INSTALLATION OF LAKE MANAGEMENT CONTROLS

Controls for managing the discharges from the lake, consistent with the Administrative Order, include three new spillway gates completed in 2010 (Figure 2, a & b) with four discharge valves—two 6-inch and two 18-inch, a weir at the discharge from the spillway stilling basin approximately 0.27 miles downstream from the dam (Completed in 2009; Figure 3, a & b), and a 42,000 gallon per minute helper cooling tower completed in 2011 (Figure 4; DEES 2014). These are in the dam or in close proximity to it (Figure 5).

**Figure 2a:** Spillway gates; photo taken from the reservoir.

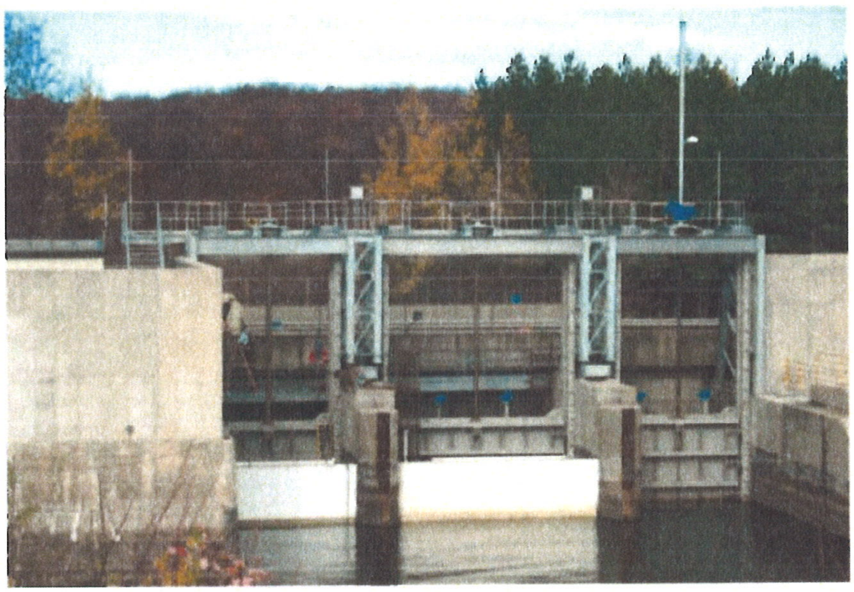


**Figure 2b:** A spillway gate showing two motorized valves, one 18-inch diameter and one 6-inch diameter driven by blue motors above the top of the gate; photo taken from inside the spillway, with staff present to show size.

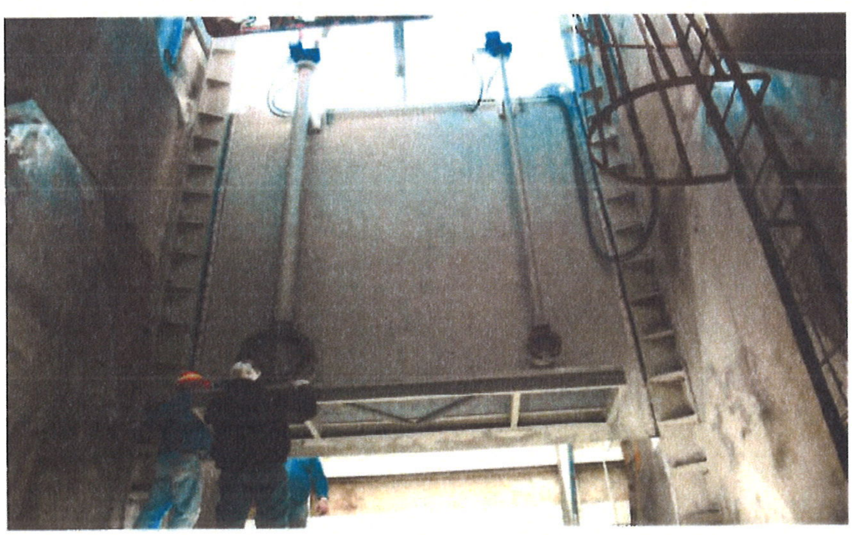




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**Figure 3a:** Weir at outlet of the spillway's stilling basin, showing flow gauging station (at left) and the weir (at right).

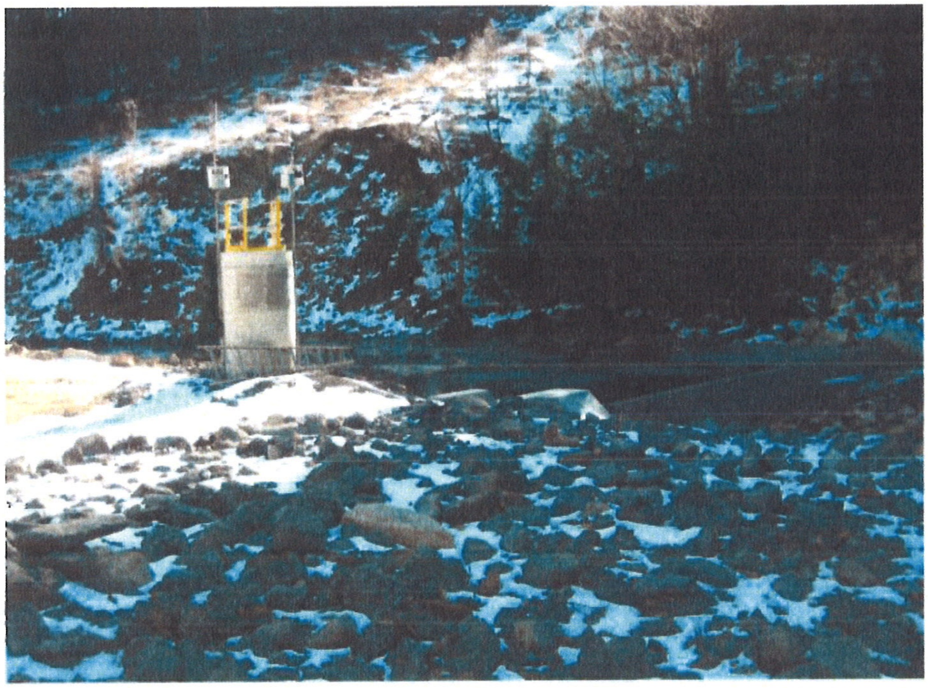


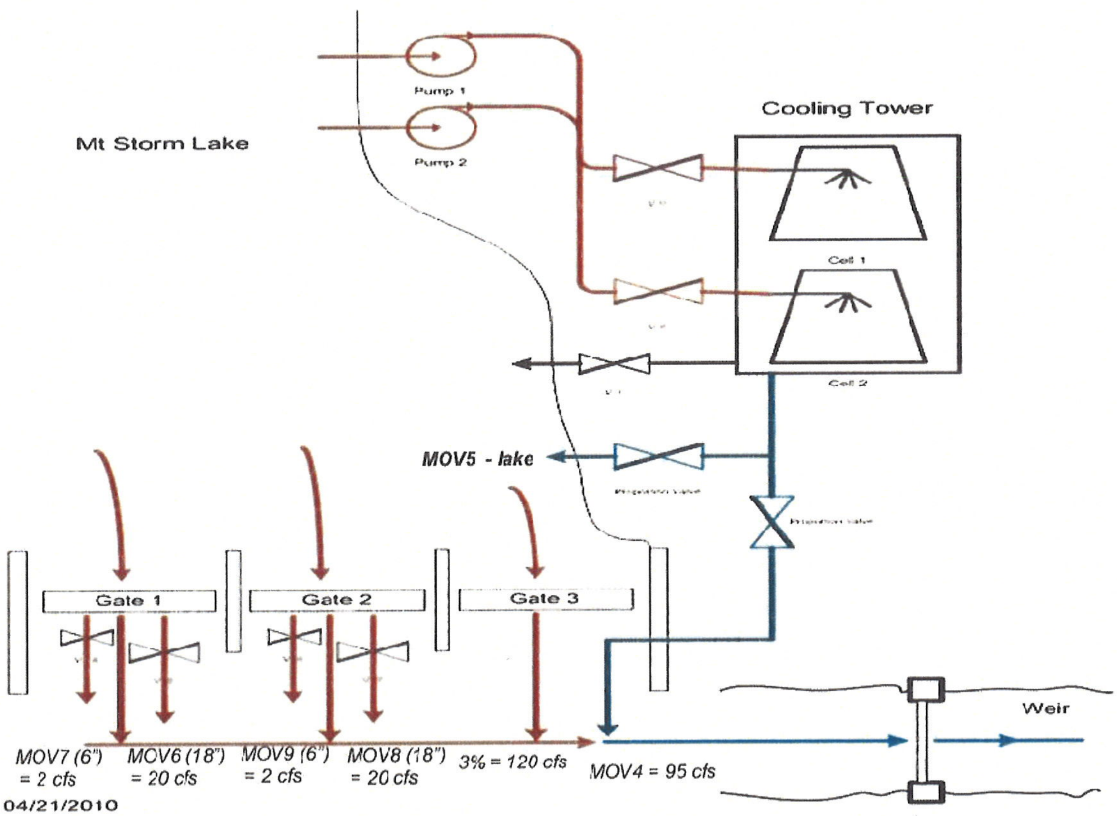
**Figure 3b:** Close-up view of the weir spillway.

**Figure 4:** Mechanical draft helper cooling tower (center) adjacent to the spillway.

**Figure 5:** Aerial view of the vicinity of the dam showing helper cooling tower, spillway gates, spillway, stilling basin, and Stony River.

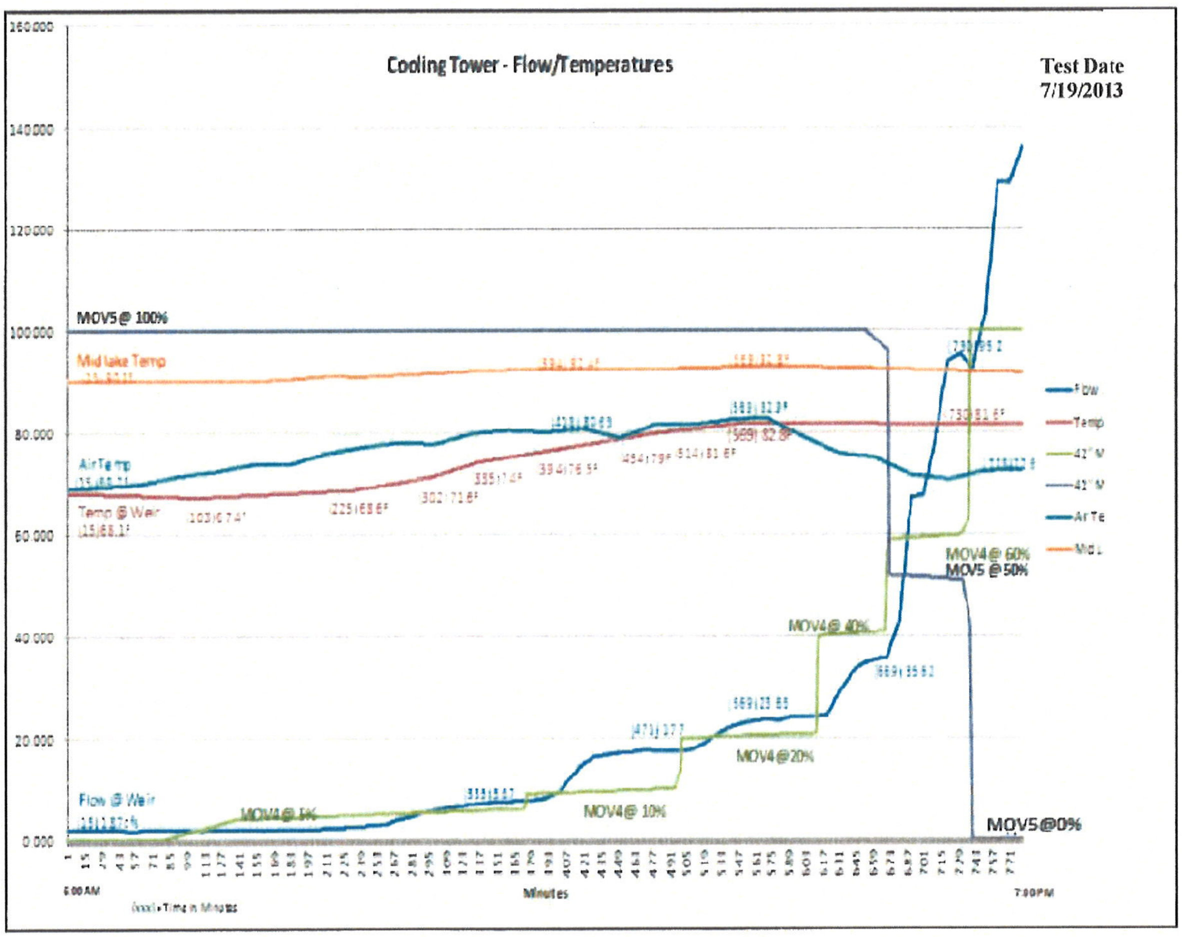
The gates and helper cooling tower are designed to provide options for mixing water to attain needed temperatures (Figure 6). Water can be released from any of three gates, which can be raised to discharge water at a depth of about 10 feet below normal pool elevation. Water can also be released through any of four motorized valves (MOV; a 6-inch diameter and an 18-inch diameter each) near the bottoms of Gates 1 & 2. The MOVs are attached to the downstream side of the gates (Figure 2b). Each 6-inch valve allows for a maximum flow of approximately 2 cfs whereas each 18-inch valve allows for a maximum flow of approximately 20 cfs. The gates allow for large-volume discharges when needed and can range from discharges of 10 cfs to over 1,000 cfs. When the combination of releases from the gates is insufficiently cool to met standards at the stilling basin's weir, the helper cooling tower can be utilized. It is designed to withdraw water from the lake (pumps 1&2), cool it with one or two tower cells, and release a maximum of 95 cfs to the spillway through MOV4. The tower can also discharge to the lake (e.g., through MOV5), which is used for start-up purposes to allow the helper cooling tower to stabilize before releasing water to the spillway.

**Figure 6:** Alternative routes for water releases to the Stony River at the Weir downstream of the dam's stilling basin. Water passes through valves, gates or helper cooling tower. Water flows according to arrows (orange for direct from the reservoir, blue after treatment in the helper cooling tower). Valves are indicated by X-shaped symbols. Examples of water flows are shown at bottom.



An operational plan was developed for using these controls to manage water temperatures of the lake outlet and was refined based on a series of test discharges performed during the period from August 2010-July 2013 (Attachment 1). An example test of the refined operational plan and corresponding sequential changes in release of the cooling tower discharge as lake temperatures and dam discharge changed was conducted in July 2013 (Figure 7). In this example, tower water was released initially into the lake (MOV5) to stabilize operation of the tower while a gradually increasing amount was released directly to the spillway (MOV 4). The relative proportions gradually reversed as the dam discharge increased.

**Figure 7:** Example routing changes for cool water from the helper cooling tower on July 19, 2013 as flow (measured at the weir), lake temperature, and temperature at the weir changed between 6:00 AM and 7:00 PM.



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## ABILITY TO COMPLY WITH TEMPERATURE LIMITS

### West Virginia Water Temperature Standards

West Virginia's temperature standards applicable to the Stony River are set forth in 47CSR2, Appendix E, Table 1:

*8.29 Temperature*
*Temperature rise shall be limited to no more than 5°F above natural temperature, not to exceed 87°F at any time during the months of May through November and not to exceed 73°F at any time during the months of December through April. During any month of the year, heat should not be added to a stream in excess of the amount that will raise the temperature of the water more than 5°F above natural temperature. ... The normal daily and seasonable temperature fluctuations that existed before the addition of heat due to other natural causes should be maintained.*

"Natural" is defined as follows:

*2.11. "Natural" or 'naturally occurring" values or "natural temperature" shall mean for all of the waters of the state.*
*2.11.a Those water quality values which exist unaffected by—or unaffected as a consequence of—any water use by any person; and*
*2.11.b. Those water quality values which exist unaffected by the discharge, or direct or indirect deposit of, any solid liquid or gaseous substance from any point source or non-point source.*

47 CSR 2, Part 2.11

### Compliance Point and Basis

The WVDEP has established that the monitoring point for regulating temperature from the Mount Storm Power Station shall be in the Stony River downstream of the dam at the weir that exits at the spillway's stilling basin, approximately 0.23 miles below the dam, which is designated Outlet 001 or monitoring station SROA.

The WV/NPDES permit for the Mount Storm Power Station (Permit No. WV0005525) was recently reissued with an effective date of August 1, 2014. The reissued permit includes both (1) a maximum temperature limit and (2) a temperature rise limit.

Part A.001 of the reissued permit contains instantaneous seasonal maximum temperature limitations on Outlet 001 that are equal to West Virginia's maximum temperature water quality criteria of 87° F (summer) and 73° F (winter). Part A.001 requires continuous monitoring as the measurement frequency for compliance with these maximum limits. Item 10 in the Fact Sheet Addendum to the permit provides the rationale for the temperature limits at Outlet 001 and includes the following statement defining the relationship between the instantaneous limits and the required monitoring frequency:

"The agency believes that an average monthly temperature limit [as required by 40 CFR 122.45] is not necessarily practicable [for temperature] and that if a permittee is continuously monitoring for temperature (with readings recorded at least once per hour) that the imposition of an average monthly limitation is not necessary and that the maximum daily limitation imposed as an instantaneous maximum limitation will be protective of water quality criteria."

Based on the above, permit condition C.6 states that "continuous measurement of temperature, as required by Section A of this permit, shall be measured at a frequency of at least once every hour."

**Compliance with Maximum Temperature Limitations**

Compliance with the maximum temperature limitations is ensured by the newly constructed facilities for controlling lake discharge—gates, valves, cooling tower, and weir—along with the Operational Plan. Compliance with the daily maximum temperature standards of 87° F in May 1-November 30 and 73° F in December 1-April 30 is illustrated by temperatures recorded at the weir in 2010 through 2013, including years when new controls were placed in operation with interim limits in place (2010-2011) and after all the new facilities have been operational (2012-2013: Figures 8 and 9). The figures represent an average for three temperature probes at the weir on an hourly basis.

**Figure 8:** Maximum water temperatures at the weir (Outfall 001) between January 1, 2010 and December 31, 2011 compared to the special interim and general water temperature standards.

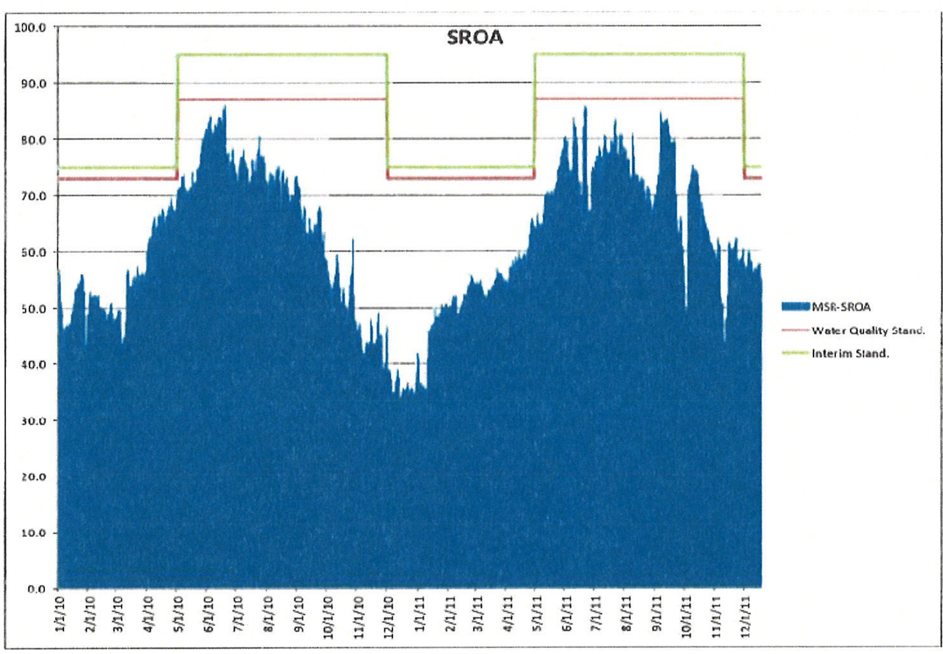
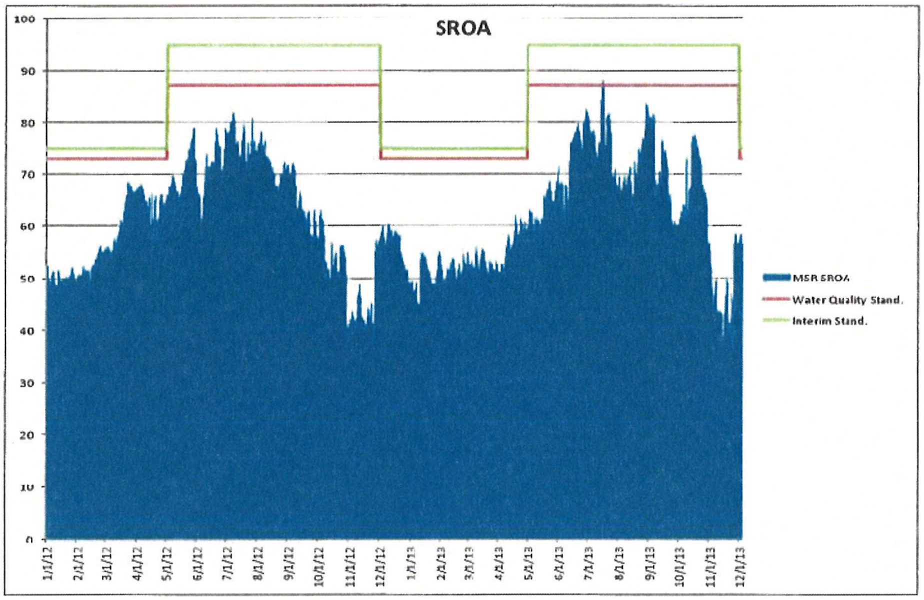


**Figure 9:** Maximum water temperatures at the weir (Outfall 001) between January 1, 2012 and December 1, 2013 compared to the special interim and general water temperature standards.




Reported temperatures were less than the water quality maximum temperature standard of 87° F in May-November and below 73° F in December through April during the entire study period (January 2010 through December 2013), except on one occasion on July 15, 2013. The reported temperature at the weir was slightly greater than the water quality standard of 87° F for a period of six hours (from 13:00 to 19:00). This exception occurred during the period of interim temperature requirements under the order. The maximum temperature recorded during this period was 88.02° F. This elevated temperature was not the result of equipment failure or equipment non-performance; rather a human communication error caused a delay in utilizing the helper cooling towers. Based on this event, the protocols for internal communications regarding helper cooling tower start-up were updated and implemented.

**Summary of ability to comply with the maximum temperature limitations:**
**New facilities and an operational plan have been successfully designed, constructed and implemented to meet the seasonal upper temperature limitations, which are now effective limits in the recently reissued permit.**

**Compliance with 5°F Rise Limitation**

*Upstream-Downstream Comparison is Inappropriate*

Part A.001 of Mount Storm Power Station's NPDES permit contains an instantaneous maximum temperature differential limit of 5° F, which is to be determined as the difference between the discharge temperature measured at Outlet 001 and the temperature



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measured in the Stony River upstream of Mount Storm Lake. The monitoring frequency for compliance with this requirement is once per week. With respect to "instantaneous", permit condition C.25 requires that there be no more than thirty minutes between the time of collection between the upstream temperature and effluent temperature.

The location of the Mount Storm Power Station on a specially built reservoir has introduced issues of interpretation of the 5° F-rise standard. Consequently, in order to allow time to address these issues the WVDEP amended the Administrative Order to extend the compliance deadline to meet the final temperature differential limitation at Outlet 001 until December 31, 2014.

Mount Storm Lake interrupts the Stony River and discharges discontinuously to the re-formed river downstream. The West Virginia water quality standards for temperature, including the 5° F rise standard, were written in the 1960s with federal guidance (FWPCA 1968) at a time when thermal-electric power stations were built mainly on large rivers (e.g., the Ohio River). It was then logical and straightforward to compare mixed river temperatures upstream and downstream of the station's thermal discharge to determine if the river's temperature was raised by 5° F or more. The WV standard is nearly verbatim from the federal guidance (FWPCA 1968), which includes the recommendation for a 5° F maximum rise, stated in a way that refers to rivers ("at the expected minimum daily flow for that month"; page 42). Importantly, neither the federal guidance nor the WV standard specifies an upstream-downstream comparison.

It has been recognized that this "upstream-downstream" comparison approach is inappropriate in many circumstances (National Academy of Sciences/National Academy of Engineering [NAS/NAE] 1973; Brungs and Jones 1977; Environmental Protection Agency and Nuclear Regulatory Commission [EPA & NRC] 1977; Langford 1990). Mount Storm is clearly one of those circumstances. NAS/NAE, Brungs and Jones, and EPA and NRC favored an approach that would set limitations based on temperature requirements of the local species rather than an increment above "natural". Langford described numerous power station studies in North America and Europe with a variety of regulatory limits. The inapplicability of an upstream-downstream comparison for Mount Storm has been discussed between Dominion and the WVDEP staff and the purpose of this paper is to propose an alternative.

Given the above, a measure that compares temperatures over time at the single monitoring station at the weir is more appropriate. A single monitoring station is appropriate because the stilling basin and weir are the sole headwaters for the Stony River downstream of the dam. The regulatory limitation for this approach would be one that prevents a detrimental change in temperature between successive monitoring measurements based on the thermal requirements of the aquatic species present.

*Dominion's Proposed Permitting Approach*

Dominion proposes applying WV's 5° F limitation to the difference between successive hourly monitoring readings at Outlet 001 when lake discharges are controlled. Such a rate of change approach is consistent with the published standard, is biologically justifiable and is within the demonstrated capabilities of the Lake Management System. This limitation is technologically achievable with the current temperature monitoring equipment and reporting procedures, can be lawfully implemented in the WV NPDES permit, and can be demonstrated to be protective of aquatic life at temperatures below the standards for maximum temperatures allowable, as described below.

*Biological Justification: The 5° F rate-of-change proposal is Protective of Stony River Biota*

The recommended approach is justified biologically by the tolerances of the local aquatic life, especially fish, to temperature changes. These responses include both lethal and sub-lethal effects. Documentation of such tolerance includes general information on responses of fish to temperature as published in the scientific literature and information specific to local species of interest. The species that have been selected for attention in the Stony River by agency and company staff (the Representative and Important Species; RIS) are listed in Table 1.

**Table 1.** Representative and Important species (RIS) selected by WVDEP for attention in the Stony River downstream of the Mount Storm project.

| Common Name | Scientific Name |
|---|---|
| central stoneroller | (*Campostoma anomalum*) |
| smallmouth bass | (*Micropterus dolomieu*) |
| spotfin shiner | (*Cyprinella spiloptera*) |
| channel catfish | (*Ictalurus punctatus*) |
| green sunfish | (*Lepomis cyanellus*) |
| blacknose dace | (*Rhinichthys atratulus*) |
| white sucker | (*Catostomus commersoni*) |
| creek chub | (*Semotilus atromaculatus*) |
| fantail darter | (*Etheostoma flabellare*) |
| northern hogsucker | (*Hypentelium nigricans*) |
| bluegill | (*Lepomis macrochirus*) |
| largemouth bass | (*Micropterus salmoides*) |
| native crayfish | |

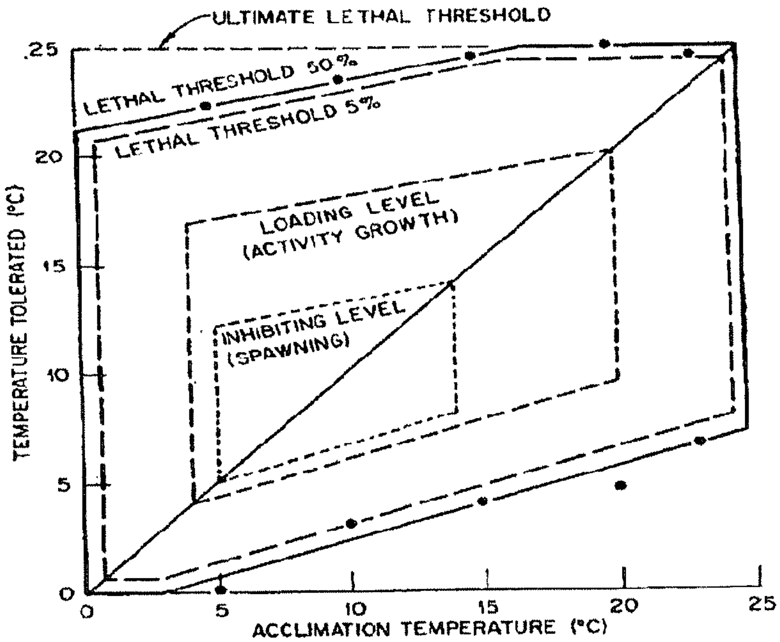
Tolerance of temperature elevations, both acute and chronic, depends highly on the acclimation state of an organism. Acclimation temperature is the temperature that an organism is biochemically adjusted to as a result of prior exposure temperatures (NAS/NAE 1973). Acclimation states of resident aquatic life are particularly important for selecting temperature limitations based on a single station, as proposed for Mount Storm. For the Stony River, the temperature one hour before a monitored temperature could be considered the "acclimation temperature" for a given temperature-change event. This would be so, especially if a rise to that temperature had been gradual over a period of several hours. It would thus be the baseline for evaluating an organism's tolerance of the thermal change in the next hour.

As basic background for understanding acclimation, the "temperature polygon" is a useful representation (Figure 10; Brett 1960). The polygon shows that the range of temperatures tolerated by an organism (vertical axis) depends on the prior exposure temperature (horizontal axis). "Tolerated" or lethal threshold has been determined by several methods (the most common being "incipient lethal," which is the 50% survival temperature of a test group after rapid immersion into the new temperature and "Critical Thermal Maximum," which is the endpoint temperature for loss of equilibrium during gradual heating). Although the numerical endpoints differ somewhat between methods, the basic pattern of acclimation is exhibited (Beitinger et al. 2000). As acclimation temperature increases, the thresholds for acute and chronic effects also increase. For example, when a fish is acclimated to 15°C (59°F) and placed into water less than 4°C (39.2°F) or greater than 25°C (77°F), then mortality is likely. At any temperature within the polygon, the fish would survive. Non-lethal endpoints also follow the same general relationship, as shown by the dashed polygons. For example with regard to growth, the temperatures between 7°C and 17°C would promote active growth in the fish when acclimated to 15°C (59°F). Pacific salmon are used as the example; actual numbers are species specific and are higher for the warm-water fish species in the Stony River.

When exposure temperatures change for fish, the process of acclimation proceeds rapidly in the first minutes to hours whereas reaching the final acclimation state may take several days (Figures 11 and 12). Figure 12 shows the change in acclimation state of 8-month-old channel catfish (an RIS in the Stony River) over time after three instantaneous temperature increases: from 10 to 20° C (50-68° F), 20 to 30° C (68 to 86° F) and 30 to 35° C (86 to 95° F) (Bennett et al. 1998). Acclimation state of individuals from the test group of exposed fish was measured at timed intervals by the Critical Thermal Maximum (CTM) procedure with the fish held at gradually rising temperatures (0.15°C/min; 0.3°F/min) until loss of equilibrium (inability of the fish to maintain dorso-ventral orientation for at least one minute (Coutant 1969). CTM values for the group of exposed fish were calculated as the arithmetic mean temperature at which loss of equilibrium occurred (Cox 1974), which is the vertical axis of Figure 12. In each temperature increase, acclimation state changed rapidly in the first hour to approximately half of its eventual state. Change in state occurred most rapidly when the change in exposure temperature was in a higher temperature range. A similar pattern for rate of acclimation (up and down) was found for a tropical salt-marsh fish (Chung 1981), indicating that these changes in acclimation state are typical of fish in general.

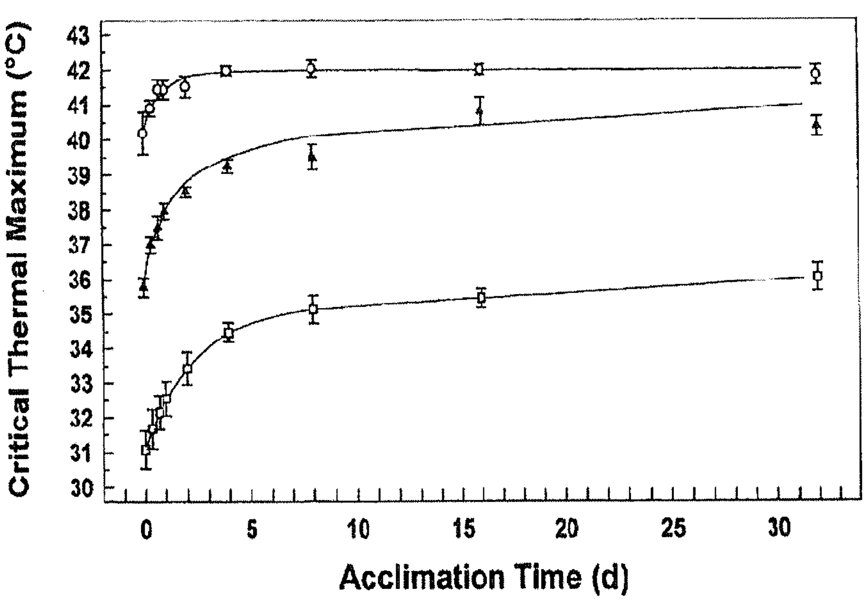
Although most published temperature requirements of aquatic organisms (used in summaries such as the temperature polygon and found in literature summaries such as Wismer and Christie 1987) are based on acclimation to constant temperatures, the real world consists of fluctuating temperatures over several time scales (rapid, daily, seasonal). Fish in fluctuating temperatures tend to be acclimated to temperatures higher than the average of the fluctuations because of the more rapid rate of change in acclimation state when temperatures increase than when they decline.

**Figure 10:** Dependence of tolerated temperatures on acclimation temperatures, shown as a "Temperature Polygon" using temperatures for



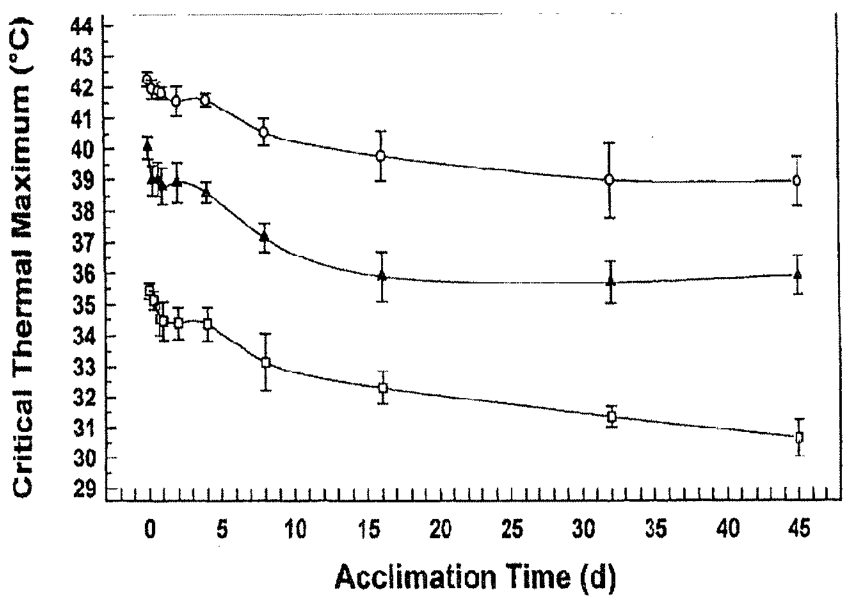

Pacific salmon as an example (actual numbers are species specific)(from Brett 1960).

**Figure 11:** Gain of heat tolerance (Critical Thermal Maximum; CTM) over time for channel catfish after instantaneous temperature changes. Fish were transferred from 10°C to 20°C (50 to 68°F) (lower, open squares), from 20°C to 30°C (68 to 86°F) (middle; solid triangles), or from 30°C to 35°C (86 to 95°F) (top; open circles). Error bars represent 95% confidence intervals; 10 fish were used for each point. (Bennett et al. 1998).



Acclimation to lowered temperatures occurs somewhat slower than acclimation to increased temperatures (Figure 12). Nonetheless, there is rapid initial change in acclimation state followed by more gradual change to the final state over several days.

**Figure 12:** Loss of heat tolerance (CTM) over time for channel catfish after instantaneous temperature changes. Fish were transferred from 20°C to 10°C (68-50°F) (lower, open squares), from 30°C to 20°C (86 to 68°F) (middle; solid triangles), or from 35 to 30°C (95 to 86°F) (upper; open circles). Error bars represent 95% confidence intervals; 10 fish were used for each point. (Bennett et al. 1998).



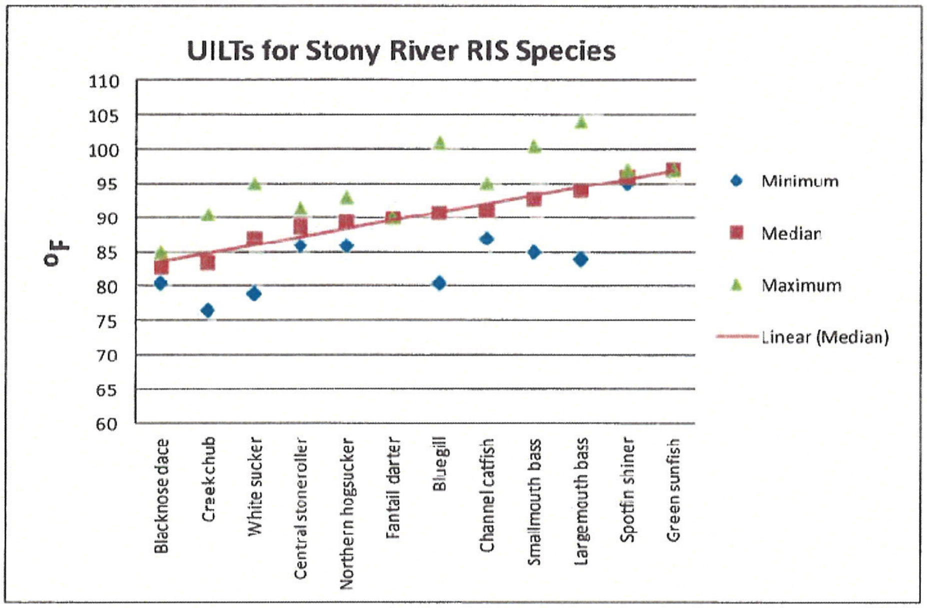

Acclimation states between the average of the fluctuation and the maximum exposure temperature are common (Cox 1978). This causes fish to be more tolerant of temperature increases than would be expected from the average temperature of the fluctuation (Brett 1960). For example, studies by Otto (1974), Heath et al. (1993), and Bennett and Beitinger (1997) all found that fluctuating temperature regimes increase a fish's tolerance of high temperatures compared to expectations based on the average of the fluctuation. Similarly, Feminella and Matthews (1984) subjected orangethroat darters (*Etheostoma spectabile*) collected from different thermal environments to Critical Thermal Maximum (CTM) determinations and found that fish from the stream with highest daily temperature fluctuation had higher CTMs (i.e., greater tolerance) than those from the thermally stable stream. On the other hand, a study by Currie et al. (2004) found only slight (not statistically significant) enhancement in overall temperature tolerance as a result of exposure to fluctuating temperature regimes for three species, channel catfish (*I. punctatus*), largemouth bass (*M. salmoides*) and rainbow trout (*Oncorhynchus mykiss*). Rainbow trout showed tolerance midway between that expected for the average and peak temperatures whereas the other two species showed small elevations in tolerance above that expected for the midpoint. The authors attributed their differing results to the specific thermal cycle studied, which held the fish at the warm temperatures for only a short period of time compared to other studies. Amplitude of the changes apparently affects the results, leading Threader and Houston (1983) to suggest an optimum cycle amplitude for a species. Whether the peak temperature of the cycle is above the physiological optimum temperature for the species (as it was in the Currie et al. studies, which peaked at 30°C or 86°F) likely influenced the results (Coutant et al. 2008).

Experiments investigating the effects of fluctuating temperature on growth have also produced important results. Greater growth under conditions of daily temperature fluctuation has been observed in laboratory studies by Cox and Coutant (1976) and Konstantinov and Zdanovich (1987). However, the difference in growth under these conditions is not necessarily just a function of the amount of variability, but is also a function of how near the mean and maximum temperatures are to lethal or stressful levels. Hokanson et al. (1977) found that temperature fluctuations within the preferred temperature range resulted in greater growth than constant temperatures with the same mean, but when the mean of the fluctuating regime exceeded the optimal temperature range, constant conditions resulted in greater growth than did the fluctuating regime. A more thorough review of the literature has shown that fluctuations, even ones of 10 degrees (F) or more, are of little significance for fish well-being if the upper or lower tolerance limits are not exceeded for long periods of time (Coutant et al. 2008).

In the lower Stony River immediately below the weir, the temperature fluctuates under two distinctive conditions: (1) diurnal fluctuations due to natural solar heating and air temperature changes under conditions where lake water is not being discharged through dam control devices, and (2) fluctuations related to initiation of lake releases and subsequent shut-off where the river experiences a rise in temperature over some period of time during releases, then temperature decreases to non-discharge levels after releases cease or are greatly reduced. With the new dam controls, a helper cooling tower, and mixing in the stilling basin, temperature increase and subsequent decrease under condition 2 are very slow (i.e., over several hours). These rates are sufficiently slow that acclimation can be occurring that results in enhanced tolerance to elevated temperatures.

The fish species in the Stony River have a range of lethal temperatures, both within and among species (Figure 13). Data on lethality are the most extreme of the biological responses but are the most abundant and available (Wismer and Christie 1987; Beitinger et al. 2000). Lethal temperatures are commonly expressed as the Upper Incipient Lethal Temperature (UILT). This is the temperature that is lethal to 50% of a study population over a one-week exposure after transfer immediately from an acclimation temperature to a new temperature. The UILT's will change with differing acclimation temperature, such that for each RIS species, there is a minimum UILT (usually associated with a low acclimation temperature) and a maximum UILT (associated with a high acclimation temperature). Based on these data, a median UILT was calculated for each BIP species. Figure 13 illustrates these data, with the blacknose dace having the lowest average UILT and the creek chub having the lowest observed UILT. These are also the only two species with average UILTs less than the summer maximum water quality standard of 87 °F (relevant only for interspecies comparisons because UILTs are for constant exposures for one week, conditions that do not occur in the Stony River).

**Figure 13:** Upper Incipient Lethal Temperatures (UILT) for Representative Important Species (RIS) in the Stony River. Minimum and maximum reported values represent the range of acclimation temperatures tested in various studies, with the median values shown to show the trend in tolerance among species. From various sources as summarized by Wismer and Christie 1987.




The generalization that lethal temperature thresholds increase with increased acclimation temperature (temperature polygon of Figure 10) is valid for the Stony River's RIS (Figure 14). The UILT for the five species with adequate data show a distinct trend for increasing tolerance with higher acclimation, with species differences and despite variability among published studies (multiple dots for a single species at one acclimation temperature).

A different view of these data is more useful for selecting an acceptable rate-of-change temperature-rise limitation for the Stony River. It is helpful to view these data as the amount of temperature rise that can be tolerated for a week at each acclimation temperature (Figure 15). In Figure 15, the vertical axis is now the difference in temperature between the acclimation temperature and a fish's UILT (the tolerable delta-T or $\Delta T$). The tolerable $\Delta T$ is greater than 5°F for most acclimation temperatures (much greater at lower acclimation temperatures). For example, consider a fish acclimated at 67°F. The most sensitive fish species (represented by the red dots) could withstand an instantaneous temperature increase of 15°F without 50% mortality.

**Figure 14:** Lethal thresholds (Upper Incipient Lethal Temperatures, UILT) for five Stony River fish species at different acclimation temperatures. The data represent multiple studies from the literature, which often give slightly different results for each acclimation temperature (thus multiple points for a species).

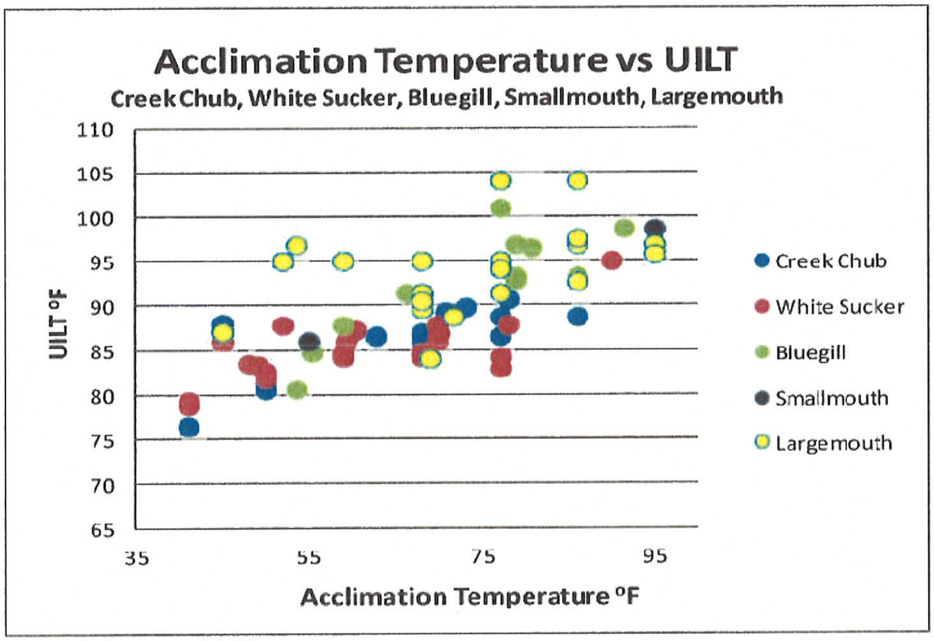
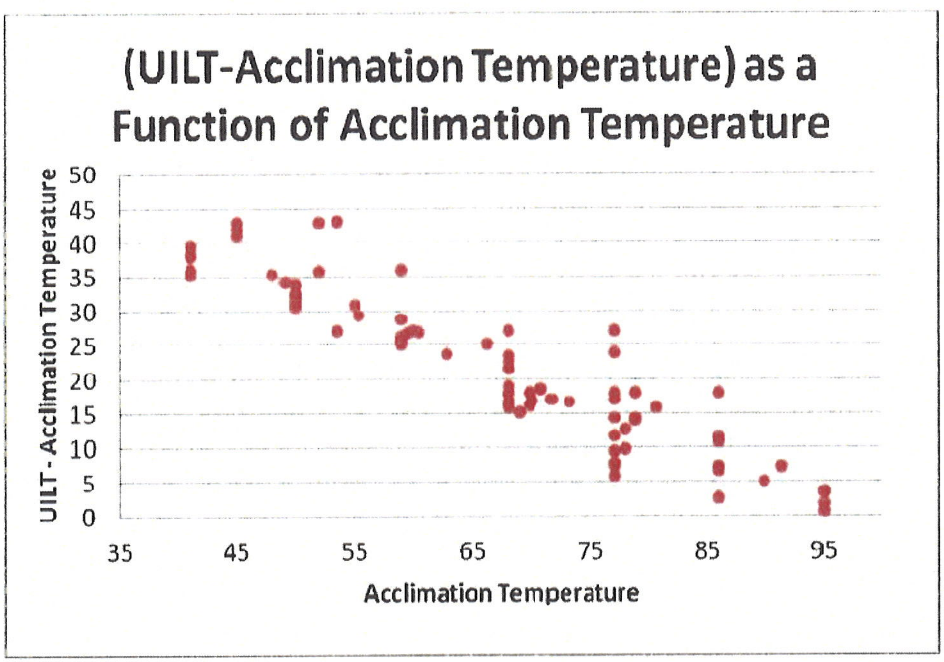


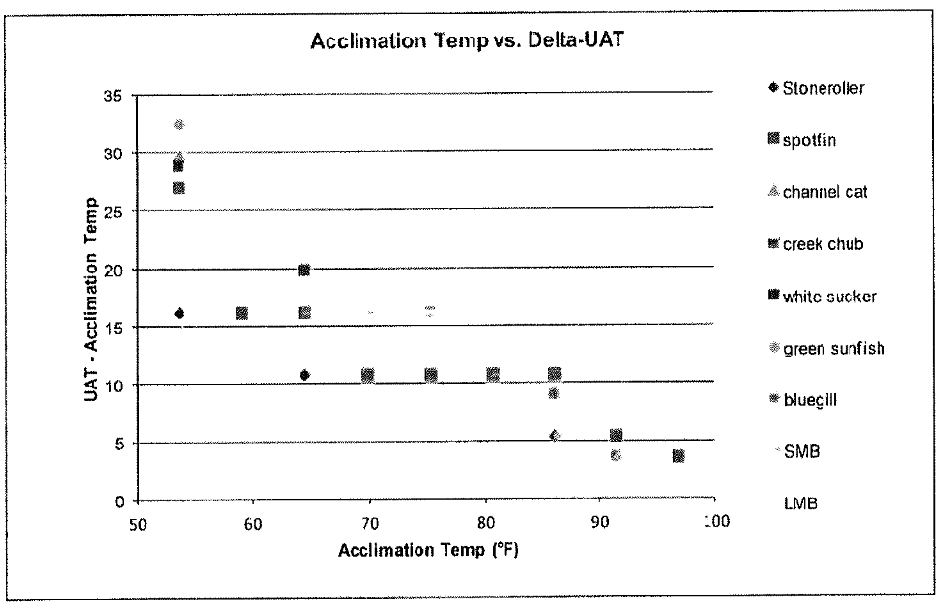

**Figure 15:** The difference in temperature (ΔT; UILT minus acclimation temperature) between acclimation temperature and Upper Incipient Lethal Temperature (UILT) for Stony River RIS shown in Figure 15.



An instantaneous temperature rise of 5°F or less at all time, expressed as a Δ 5°F/hour rate of change limit measured at the weir below the dam would protect aquatic organisms from lethality until you approach an acclimation temperature of 85°F. At that point, the water quality standard for maximum temperatures would protect the aquatic organisms in the Stony River because a 5°F rise would result in higher than the summer limitation of 87°F.

A more ecologically relevant endpoint for protection against damaging high temperatures would be better than prevention of acute lethality, however. It has long been recognized that the fish themselves could make this decision in the form of the Upper Avoidance Temperature (UAT; Cherry et al. 1975, 1977; Coutant 1977). When placed in an experimental temperature gradient or tracked in the field with temperature-sensing telemetry, a fish will demonstrate avoidance behavior at a certain high temperature. The UAT is species specific, just as is the UILT. This temperature is nearly always lower than the species' UILT. The UAT generally coincides with the temperature at which capability for growth diminishes markedly. Upper Avoidance Temperature data can be displayed for Stony River fish species in a manner similar to Figure 16 so that it illustrates the ΔT between acclimation temperature and UAT (Figure 16). For example, consider a fish acclimated at 65 °F. The most sensitive fish (stoneroller in this case) could withstand an instantaneous temperature increase of 10 °F without reaching its behavioral UAT. As is the case for lethality, fish can tolerate temperature rises greater than 5°F until acclimation temperatures reach the mid 80s (°F) when a 5°F rise would be prevented by the 87°F upper temperature limitation in summer.

**Figure 16:** The difference in temperature (ΔT; UAT minus acclimation temperature) between acclimation temperature and the Upper Avoidance Temperature (UAT) for Stony River RIS.



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Reproduction is another important sub-lethal feature that needs to be protected. Temperatures need to be protective of reproduction as well as individual organism well-being. As the temperature polygon (Figure 10) indicates, the range of acclimation and tolerated temperatures is more restrictive than those for lethality or other physiological activities such as activity and growth. The temperatures demonstrated for 2012 and 2013 in the Stony River and those anticipated with the temperature management system indicate that spawning should not be greatly altered.

Reproduction of warm-water fish, such as those in the Stony River, is keyed by cool-season maturation (oogenesis and spermatogenesis) and the temperature and day length during the spawning season (Pankhurst and Porter 2003). Photoperiod is commonly viewed as the principal environmental determinant of reproductive development (Bromage et al. 2001), and is the only variable capable of delivering an unambiguous "date" signal for reproduction (Pankhurst and Porter 2003). Temperature appears to act as a secondary cue at temperate latitudes that interacts with the photoperiod signal so as to synchronize the final stages of reproductive development with optimal environmental conditions, and signals the end of reproductive episodes (Van Der Krank and Pankhurst 1997; Pankhurst and Porter 2003).

High reproductive adaptability to different temperature regimes by the RIS species in the Stony River is demonstrated by their wide distribution across latitudes of North America. Distribution, spawning times, spawning temperatures and Dominion's conclusion of RIS species are summarized in Attachment 2 with the information source. The information is summarized in Table 2.

**Table 2:** Stony River RIS's Wide Geographic Distributions Suggest Thermal Flexibility for Reproduction

| Species | Distribution | Spawning Temperatures |
|---|---|---|
| Central stoneroller | NY-MN, Miss. R. Valley-Mexico | Mid Feb-Mid July. 58-75$^{o}$F |
| Smallmouth bass | Southern QE-ND, Miss. R. Valley-Mexico | Mar-May >50$^{o}$F |
| Spotfin shiner | Southern QE-WI, Miss. R. Valley-AL&OK | Not well documented |
| Channel catfish | Throughout lower Canada & U.S. | May-July, opt. 77-80.6$^{o}$F |
| Green sunfish | Central NA, NE Mexico & So Canada | May-Aug >70$^{o}$F, multiple |
| Blacknose dace | Manitoba-Maritimes, south to AL & GA | May- July; 59-72$^{o}$F |
| White sucker | Yukon-Labrador, south to OK, GA, AL | Spring 50-64$^{o}$F |
| Creek chub | East of Rocky Mtns, So Canada-GOM | Apr-July, >57$^{o}$F |
| Fantail darter | Gt. Lakes & Miss. R. basin, SC-OK | >63 to 68$^{o}$F |
| Northern hogsucker | So ON-MN to No GOM states, Atl. Slope | May, >59$^{o}$F |
| Bluegill | So Quebec-Mexico, widely introduced | May-Sept, 63-88$^{o}$F |
| Largemouth bass | Native to East US, but now worldwide | Feb-July in US, >64$^{o}$F |

Water somewhat warmer than the groundwater sources that supply the Stony River downstream of the dam is likely to be released from the lake to the stilling basin throughout much of the year. However, heat generally dissipates quickly in streams during cool months when gonad maturation takes place. In the Stony River, the temperature increase observed at the stilling basin, is progressively reduced at stations further downstream (DEES 2005, Figures IV.D.1.2 – IV.D.1.4).

The most commonly suggested effect of warmer water on reproduction of warm- and cool-water fish is earlier spawning. There is abundant evidence that earlier spawning likely benefits population strength in cool, temperate latitudes. This is largely because earlier reproduction leads to larger individuals that are more capable of avoiding predation and succeeding in overwintering. Studies show that survivorship can be biased toward larger individuals. Size-selective predation (Post and Prankevicius 1987; Post and Evans 1989a, Litvak and Leggett 1992), size-dependent feeding and starvation (Miller et al. 1988, Bernard and Fox 1997), and size-dependent overwinter mortality (Oliver et al. 1979; Toneys and Coble 1979; Shuter et al. 1980; Post and Evans 1989b; Smith and Griffith 1979, Bernard and Fox 1997) have all been implicated in greater year-class strength of larger individuals. Larger individuals often arise from earlier spawning. For example, Cargnelli and Gross (1996) studied multiple spawnings of bluegill and found that fry born earlier in the season were larger and had higher survival to age 1 than fry from the middle or late season (231% better representation as yearlings). Both increased over-winter survival and size-selective predation were indicated in that study. Casselman (2002) wrote that warming would substantially increase year-class strength of warmwater species, such as smallmouth bass, which was positively correlated with July-August temperatures in the Great Lakes basin. An additional increase of 1°C increased abundance by 2.5 times, 2°C by 6 times and 3°C by 14.7 times. King et al. (1999) showed that smallmouth bass grew better as the availability and duration of warmer water temperature increased in Ontario lakes. Early spawning allowed riverine smallmouth bass to re-nest multiple times when a study river in Virginia was repeatedly impacted by high flows (Lukas and Orth 1995).

In light of the above, warmer temperatures in the Stony River likely induce somewhat earlier spawning by the warm water fish community than would have occurred had there been no lake discharges. This earlier spawning likely has been advantageous for population success. The literature is especially rich for smallmouth bass, a species that has, in fact, done well in the reach of the Stony River downstream of the dam.

**Summary of the biological justification for Dominion's rate-of-change of 5°F/hour:**

**The biological justification for Dominion's proposed 5°F rate-of-change limitation between successive hourly temperature measurements at the weir is clear given the fact that there is a more than 5°F breadth of tolerance (lethal and behavioral) for temperature increases above acclimation temperature ($\Delta T$) by RIS fish species when the prior hourly measurement is considered the acclimation temperature. This breadth narrows to less than 5°F at high summer temperatures but temperature increases at that time are limited to less than 5°F by the maximum temperature limitation. Acclimation by fish to warmer temperatures is initially rapid and at a rate sufficient to track temperature changes at the weir when hourly increases are 5°F or less. No impairment of reproduction should occur, based on the widespread geographic distribution of the Stony River's RIS and their general temperature**

**adaptability. Some advancement of spawning time may be observed in some species, which has been shown elsewhere to be advantageous for population survival. The following section illustrates actual temperatures at the monitoring station (Outfall 001, the weir) recorded when reservoir outlet controls were in place.**

*Temperature Justification: The 5°F Rate-of-Change Proposal is Within the Capabilities of the Lake Management System*

With the new dam controls and the helper cooling tower functional, a gradual increase in lake discharge with associated slow rise in discharge temperature is achievable. Using the same temperature data shown in Figures 8 and 9, discharge temperatures were compared to the temperature reading during the previous hour to calculate an hourly rate of temperature change. This was performed for the 2012 and 2013 data – after the helper cooling tower was put into service (Figures 17 and 18). In 2012, there were no temperature increases greater than 5°F/hour. In 2013, there were several occasions where up to a 5°F/hour increase was observed. Most of these were recorded during testing of the system or other abnormalities discussed below. An increase in temperature greater than 5°F/hour was observed on one occasion (July 11, 2013) when the station was not discharging. A large rain event caused a quick increase in flow and temperature at the weir without any influence from the reservoir.

**Figure 17:** Temperature changes from one hour to the next (hourly ΔT) for calendar year 2012 compared to Dominion's proposed 5°F limitation. Both temperature increases and decreases are shown.

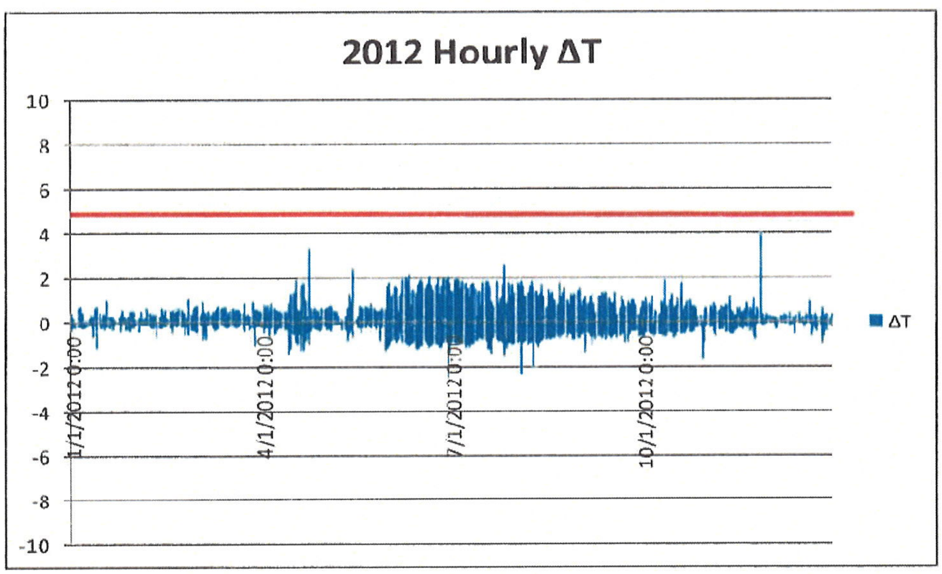




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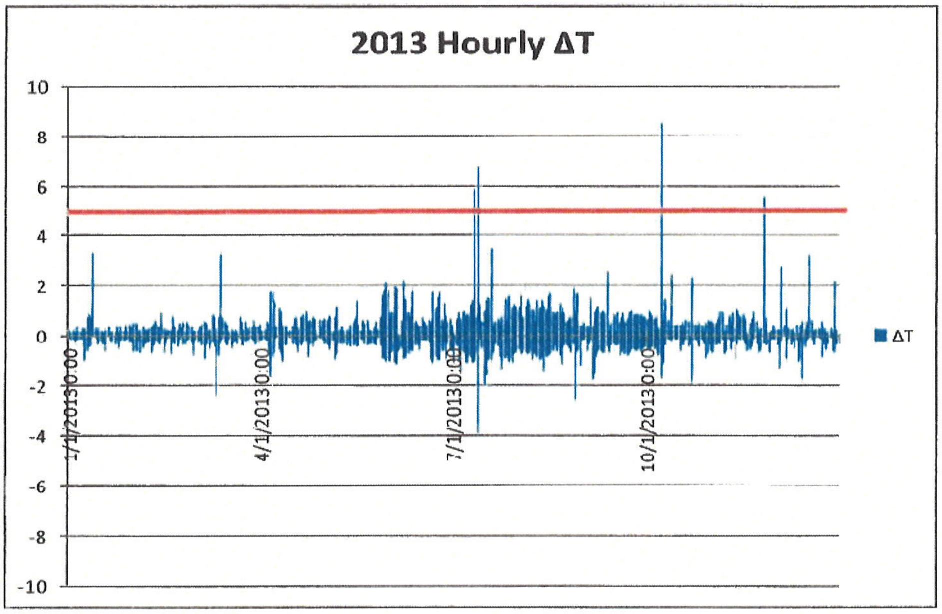
**Figure 18:** Temperature changes from one hour to the next (hourly ΔT) for calendar year 2013 compared to Dominion's proposed 5°F limitation (red line). Both temperature increases and decreases are shown.




Rates of temperature change were low for warming episodes on days with daily changes >5°F (Figures 19 and 20). These calculations were made to compare with rates of fish acclimation to warmer temperatures. Days (e.g., entire 24 hour period) with changes >5°F were selected from the full data set to represent the likely worst-case conditions for temperature changes. Rates were calculated for the whole warming period during a day (ΔT divided by the number of hours of the temperature rise = °F per hour). The figures show the extent of warming (blue bars) and the calculated degrees per hour (red bars). There were seven days in 2012 with daily temperature elevations >5°F. For all of these days, the rate of temperature change during the period of warming was less than 2°F/hour, and most often 1°F/hour or less. In 2013, there were 18 days with daily changes >5°F. Change rates in 2013 were generally 1°F/hour or less, although there were exceptions. On October 8, the rate exceeded 5°F per hour due to a unique combination of events. An 18-inch valve was mistakenly opened 100% but was quickly corrected. Also, as part of a dam-safety inspection by WV DEP a leaky stoplog was placed in one gate to allow the gates to be operated for the inspection. The leak was not controllable during the test operation of that gate. A November 25 event that exceeded 5°F was a combination of weather and operation. There was an unusual difference of about 30°F between the lake and Stony River and one of the valves was raised from 50% open to 100% prematurely.

**Figure 19:** Daily (24 hour) temperature change (blue bars) on days in 2012 when the daily change was >5°F, with the corresponding rate of change in degrees per hour (red bars).

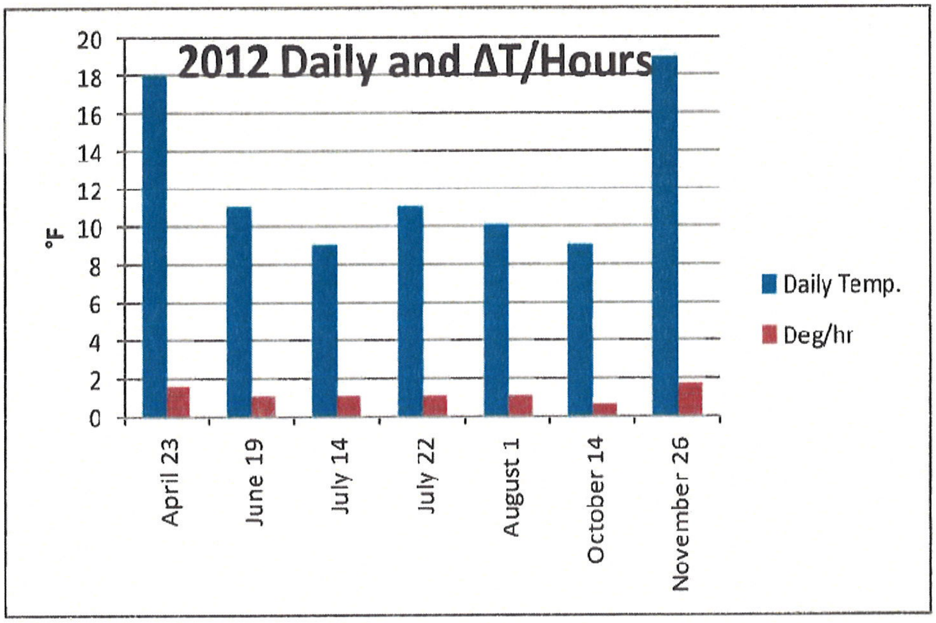
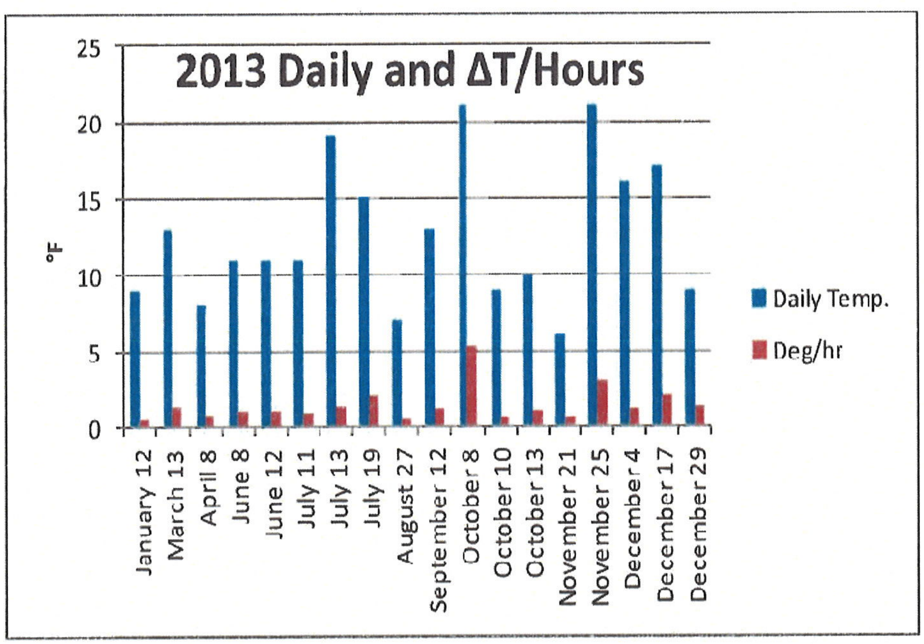



**Figure 20:** Daily (24 hour) temperature change (blue bars) on days in 2013 when the daily change was >5°F, with the corresponding rate of change in degrees per hour (red bars).



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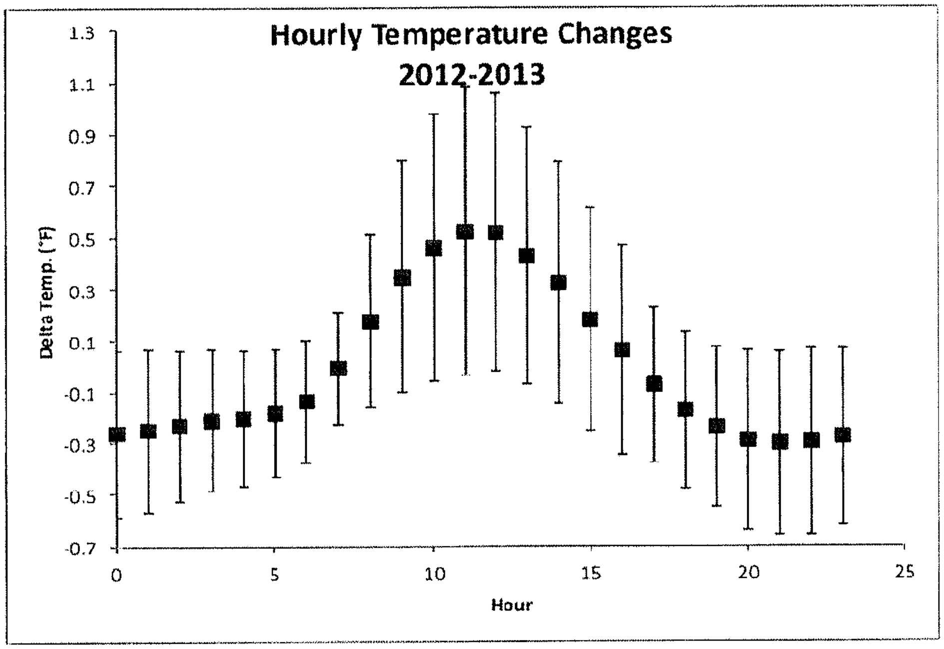
Initiation and termination of dam releases were evident in the flow record from the weir. Increases in flow generally correlated with temperature increases, while decreases in flow generally correlated with cooling and return to prior temperatures.

Changes in both flow and temperature were gradual. The amount of temperature change in each hour of the day (hourly ΔT) for the years 2012 and 2013 combined is summarized by average and standard deviation in Figure 21. In daytime (about 9AM to 4 PM) temperatures generally rose whereas at night, dawn and dusk temperatures generally declined, as one would expect. Overall, there was greater ΔT variation in daytime hours.

**Figure 21:** Hourly ΔT summarized for 2012 and 2013 combined, showing average and standard deviation.




<u>**Summary of Dominion's capabilities to achieve a rate-of-change of 5°F/hour:**</u>

**The Lake Management System is capable of maintaining a gradual rate-of-change in temperature of no more than 5°F/hour in the water that exits the stilling basin at the weir (Outfall 001) as demonstrated by 2012 and 2013 monitoring data.**

**Maintaining Normal Daily and Seasonal Cycles**

The narrative portion of West Virginia's temperature standards requires maintaining seasonal and daily temperature cycles. The existing monitoring record demonstrates that both seasonal and daily cycles are maintained in the Stony River downstream of the lake releases. Seasonal cycles of temperatures are illustrated in Figures 9 and 10 for years 2010-2013, both before and after installation of the lake discharge controls and management procedures. A daily temperature cycle was evident in 2012 and 2013 for all dates when new controls were in place despite often irregular and discontinuous releases (Figure 21).

## LEGAL CONSIDERATIONS

The existing NPDES permit for Dominion's Mount Storm power station contains a *spatial* temperature rise limit at Outlet 001, calculated by taking the difference of concurrent temperature readings upstream and downstream of Mount Storm Lake. This spatial approach (*i.e.*, upstream v. downstream) has been used elsewhere to apply the 5°F limitation for temperature rise under West Virginia Water Quality Standard 8.29 in other NPDES permit proceedings. However, given the facts and circumstances that are unique to Mount Storm explained above, a *temporal* temperature rise limit would be equally protective, equally defensible and more appropriate for Mount Storm. Such a temporal approach would be measured as the rate of change in discharge temperature over a one-hour period at Outlet 001.

### Dominion's Proposed Approach Is Legally Defensible

*The Applicable Regulations Afford WVDEP Flexibility in Interpreting and Implementing Standard 8.29*

As noted above, the temperature-based water quality standard in Appendix E.8.29 to the state regulations in 47 CSR 2 (Standard 8.29) serves as the regulatory basis for any temperature rise limit that WVDEP may seek to impose in the Mount Storm NPDES permit. Specifically, Standard 8.29 requires that "[t]emperature rise shall be limited to no more than 5°F above ***natural temperature***." 47 CSR 2, Appendix E, Table 1, Standard 8.29 (emphasis added).

The phrase "natural temperature" is defined as "[t]hose water quality values which exist unaffected by" discharges or other human-induced changes. *See* 47 CSR 2, Part 2.11. Nothing in this definition or within Standard 8.29 mandates that upstream or intake temperatures serve as the exclusive point of reference for setting the "natural temperature" baseline. Rather, the operative language provides WVDEP with discretion to determine the appropriate "natural temperature" baseline and corresponding permit limits depending on the facts and circumstances of any particular permit proceeding. By comparison, some states have defined their temperature rise standard in a manner that compels the use of upstream or intake temperatures. *See e.g.*, Ga. Comp. R. & Regs. 391-3-6-.03(6)(a)(v) ("At no time is the temperature of the receiving waters to be increased more than 5°F ***above intake temperature*** . . .") (emphasis added). WVDEP's decision to express its standard more expansively – based on a rise over the more broadly defined term "natural temperature" – underscores its discretion in interpreting and applying the "natural temperature" baseline.

The unique operating conditions at Mount Storm also serve to distinguish this permitting action and further support an alternative approach. Most notably, as discussed above, Dominion has virtually complete control over whether and when discharges from Outlet 001 occur, and these discharges comprise virtually all of the flow in Stony River downstream.

Based on WVDEP's own definition of "natural temperature," these unique circumstances justify deviating from the existing "Temp. Diff Up/Down Stream" approach. In fact, if anything, the applicable regulations should steer WVDEP ***away*** from using an upstream reference point in this case. A plain reading of the regulations confirms that the presence of Mount Storm Lake interrupts the flow of the Stony River and are; therefore, not "natural" for purposes of applying Standard 8.29 (due to multiple non-natural sources and causes of heat load to the river). Thus, for WVDEP, deviating from past practice in this instance would not constitute a break in precedent, but rather simply a different approach for a different set of circumstances, consistent with WVDEP's own regulatory directive.

Moreover, while the agency has apparently favored a "Temp. Diff Up/Down Stream" approach in prior permits, it appears to be only one of several reasonable and defensible alternative approaches within WVDEP's discretion to follow. Notably, the state's temperature rise standard is not unique to West Virginia. A number of other states have nearly identical temperature rise standards that are implemented in different ways in state-issued NPDES permits. Viewing how these states implement their respective temperature rise standards reveals a number of reasonable alternative approaches, including Dominion's proposed hourly rate of change approach. For instance, the Pennsylvania Department of Environmental Protection implements its comparable temperature rise standard in the form of permit limits expressed as calculated heat rejection rate (million BTU/day) or a mass balance, depending on the nature of the discharge in relation to the receiving water. Pennsylvania's equations allow for exceptions where ambient stream temperature data are not available or representative.[1] This equation-based approach is used in a number of states and has been endorsed by EPA. Other states with parallel temperature rise standards allow for variations in their spatial approaches using different natural condition baselines, such as downstream (as opposed to upstream) temperature or reference stream ambient temperature. *See e.g.*, Minn. R. 7050.017. These varying interpretations of the same basic temperature rise standard at issue in the Mount Storm proceeding underscore the fact that WVDEP has discretion and flexibility to adapt its interpretation of Standard 8.29 according to varying circumstances.

*EPA and WVDEP Guidance Support Dominion's Proposed Hourly Rate of Change Approach*

The use of an alternative, temporal rate of change approach is consistent with longstanding state and federal guidance. For one, this approach focuses more directly on the outfall itself as a single point of compliance. This is in line with the direction from

[1] *See* http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-74339/391-2000-017.pdf/.

WVDEP in its *Water Quality Standards/Mixing Zones Implementation Guidance* to the effect that, when establishing permit limits for discharges of this nature, "[t]he primary compliance assessment point should continue to be at the effluent, with the majority of permittee self-monitoring occurring at that location." *See* WVDEP *Water Quality Standards/Mixing Zones Implementation Guidance* (June 30, 1997). Moreover, EPA has explicitly endorsed a temporal, rate of change approach for setting temperature rise limits at power plants like Mount Storm. *See* EPA, *Review of Water Quality Standards, Permit Limits and Variances for Thermal Discharges at Power Plants*, EPA 831-R92001, Oct. 1992, at pg. 7. In that guidance, EPA confirmed that "[p]ermit limits for thermal discharges may be established as a maximum temperature at the point of discharge (POD), ***a maximum incremental temperature increase at the POD***, and/or the temperature difference between a sample taken at the POD and a sample taken at the plant intake or upstream of the POD." (emphasis added).

*DEP Has Authority and Discretion to Interpret and Implement Standard 8.29 in the Manner Recommended by Dominion*

The West Virginia legislature has granted to WVDEP "[a]ll authority to promulgate rules and implement water quality standards . . ." W. Va. Code §22-11-7b. WVDEP's freedom to apply reasonable discretion in how it interprets and applies these standards is necessarily inferred from this broad statutory authorization. This inference is backstopped by a strong policy of deference to administrative agencies like WVDEP among both federal and West Virginia state courts, particularly where the agency is making discretionary decisions on complex issues within its area of expertise. *See Frymier-Halloran v. Paige*, 193 W.Va. 687, 694, 458 S.E.2d 780, 787 (1995) ("[i]t [is] evident that courts will not override administrative agency decisions, of whatever kind, unless the decisions contradict some explicit constitutional provision or right, are the results of a flawed process, or are either fundamentally unfair or arbitrary"); *MCI Telecommunications Corp. v. Federal Communications Comm'n*, 675 F.2d 408, 413 (D.C.Cir.1982) ("the critical concern of the reviewing court is that the agency provide a coherent and reasonable explanation of its exercise of discretion"); *Appalachian Power Co. v. State Tax Dep't of West Virginia*, 195 W.Va. 573, 466 S.E.2d 424, 440-441 (1995) ("The policy favoring deference is particularly important where, as here, a technically complex statutory scheme is backed by an even more complex and comprehensive set of regulations. Under such circumstances, the argument for deference is at its strongest."); *see also Auer v. Robbins*, 519 U.S. 452 (1997). Together with the broad regulatory language at issue here – which clearly leaves room for interpretation – this strong statutory and judicial affirmation resolves any doubt as to whether WVDEP has the authority and discretion to interpret and implement Standard 8.29 in the manner recommended by Dominion.

**A Rate of Change Limit Is the Most Appropriate and Efficient Means of Accounting for Unique Circumstances at Mount Storm**

While a 316(a) variance or site-specific criteria may be viable options for accounting for both the unique circumstances at Mount Storm and the requirements under Standard 8.29, neither of these approaches is as good a fit as the interpretation recommended by Dominion.

Site-specific criteria are typically only used when the generally applicable criteria are either over- or under-protective based on unique site conditions. This is not the case with Mount Storm. Rather, here the generally applicable criteria *are* protective and appropriate; the issue is simply how to interpret those criteria given the unique circumstances at Mount Storm. As explained above, Dominion's proposed approach does precisely that – it presents a legally defensible interpretation of Standard 8.29 that accounts appropriately for the unique conditions at Mount Storm. Moreover, seeking to adopt site-specific criteria would be far less efficient from an administrative standpoint. Doing so would require WVDEP to first adopt a site-specific temperature rise standard into the state's water quality standards regulation, then get it approved by EPA, and then apply it to Mount Storm through an NPDES permitting action.

For similar reasons, a 316(a) variance is also less preferable to simply revising the permit limit consistent with a proper interpretation of Standard 8.29. The variance approach is more commonly used when the generally applicable standard cannot be immediately achieved or is not feasible. Again, this is not the case with Mount Storm. In this instance, the applicable standard *can* be achieved, provided that it is interpreted as presented in this paper. Moreover, because a variance is time-limited and must be renewed at defined intervals, this approach is less preferable from an administrative efficiency standpoint.

In summary, Dominion's proposed temporal temperature rise limit is consistent with applicable law, regulations and guidance, and is fully protective of the underlying designated uses of the receiving waterbody. Moreover, accounting for the unique circumstances at Mount Storm in this manner, as opposed to through a 316(a) variance or site-specific criteria, represents the most relevant and administratively efficient path for ensuring that appropriate, achievable and protective limits are in place.

## CONCLUSIONS AND PROPOSAL

### Conclusions

Dominion has evaluated a maximum 5°F between hourly measurements at the weir as an interpretation of WV's standard for no more than a 5°F rise above natural. Evaluation indicates this interpretation would be protective of aquatic life, achievable with the technology in place, and suitable for implementation in a WV NPDES Permit.

- Controls on discharges from Mount Storm Lake with an Operational Plan, mandated by WVDEP Administrative Order 6291 and designed and implemented with WVDEP approval, have provided the technological capability to meet WV water temperature standards for maximum temperatures of 87°F May 1-November 30 and 73°F December 1-April 30.

- Upstream-downstream comparisons of Stony River temperatures for meeting the standard of a maximum 5 °F rise from "natural" are inappropriate due to the intervening lake. The WV standard does not specify such an upstream-downstream comparison. WVDEP has discretion and flexibility to adapt its interpretation of Standard 8.29 according to varying circumstances.
- Examination of temperature records for 2012 and 2013, when controls were in place, show that hourly and daily rates of temperature change are gradual and within the capability of fish to physiologically acclimate.
- At all acclimation temperatures not constrained by the 87° or 73° seasonal maxima there is more than a 5°F breadth of tolerance for both lethal and behavioral endpoints for acceptable temperatures for the warm-water fish species in the Stony River. Thus a 5°F $\Delta$T/hour limit is adequate to protect against thermal impacts to fish downstream of the dam.
- Temperatures in the Stony River downstream of the lake are unlikely to disrupt reproductive cycles of the warm-water fish species because these species have wide geographic ranges and are highly adaptable. Any early spawning is likely to be advantageous due to larger sizes of juveniles, which affects predation and overwintering mortality.
- Both seasonal and daily temperature cycles were maintained in the Stony River downstream of Mount Storm Lake with controls in place in 2012 and 2013, as required by WV temperature standards.
- The proposed limit would be monitored continuously (as specified in the existing permit) and, even though the limit would be expressed as an hourly delta, it would still be consistent with the WVDEP's rationale for a minimum of hourly measurements as "continuous" for compliance with an instantaneous limit.

**PROPOSAL:**

**Dominion proposes that the WV temperature standard requiring no more than 5°F above natural be interpreted in this instance and expressed in the NPDES permit as a rate-of-change, during periods of release from the dam, of no more than a 5°F limit on temperature rise between hourly readings at the monitoring station at Outlet 001, (i.e., the weir at the outlet of the spillway stilling basin).**

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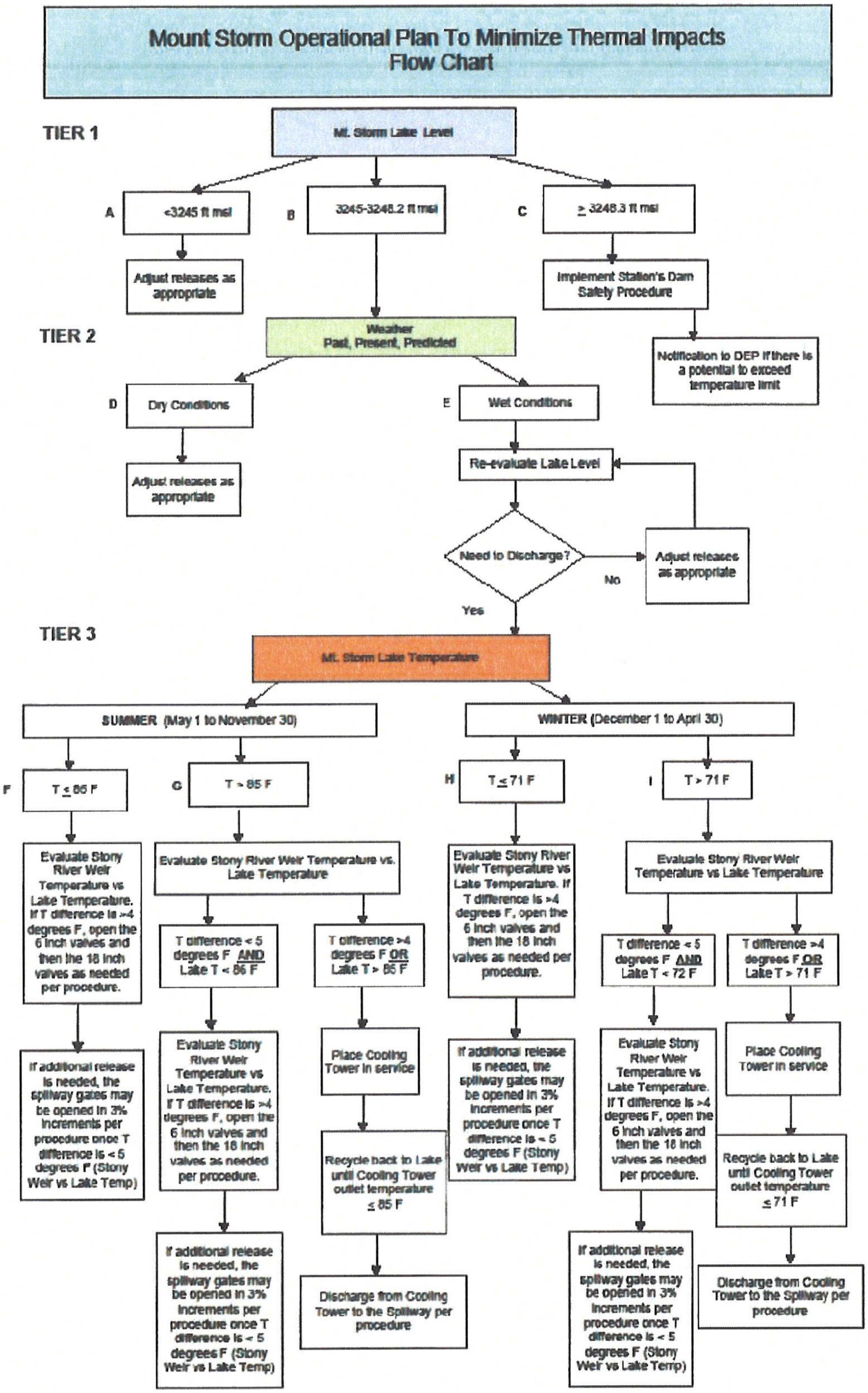
# ATTACHMENT 1



## ATTACHMENT 2

### Distribution, spawning times, and spawning temperatures of RIS species

Central stoneroller (*Campostoma anomalum*)
http://animaldiversity.ummz.umich.edu/accounts/Campostoma_anomalum/#geographic_range
Widely distributed. Found from New York west through the Great Lakes to Wisconsin and Minnesota and south through the Mississippi valley to Mexico.
Spawn once yearly from March to late May in vicinity of WV, but can be mid-February to mid-July. Water temperature and photoperiod trigger the onset of the spawning season. Spawning is between 14.5 and 24°C (58.1-75.2°F) with cessation if temperature drops to 10.5°C (50.9°F).
Conclusion: Wide geographic distribution and wide range of suitable spawning temperatures suggests tolerance of reproduction to temperature fluctuations in the Stony River at Mount Storm. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Smallmouth bass (*Micropterus dolomieui*)
http://animaldiversity.ummz.umich.edu/accounts/Micropterus%20dolomieui/
Native range Great Lakes and St. Lawrence River drainages from southern Quebec and New Hampshire to North Dakota, and Mississippi River drainage as far south as Alabama. Widely introduced successfully outside its native range and internationally.
Spawns once yearly between March and May when temperatures exceed 10°C (50°F). Nest abandonment can occur when water temperature drops below 15°C (59°F).
Conclusion: Wide geographic distribution and wide range of suitable spawning temperatures suggests tolerance of reproduction to temperature fluctuations in the Stony River at Mount Storm. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Spotfin shiner (*Cyprinella spiloptera*)
http://nas.er.usgs.gov/queries/FactSheet.aspx?speciesID=520
The native range is the Atlantic slope from the St. Lawrence River drainage Quebec to Potomac River drainage, Virginia; Great Lakes except Superior, Red River (Hudson Bay drainage), Mississippi River basins from Ontario and New York to southeastern North Dakota and south to Alabama and eastern Oklahoma. They have been stocked as forage fish in Nebraska and Virginia.
A spring spawner. Although one of the most common fishes, little information is available on specific spawning temperatures.
Conclusion: A species this widespread is likely tolerant of a wide range of temperatures for spawning. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Channel catfish (*Ictalurus punctatus*)
http://animaldiversity.ummz.umich.edu/accounts/Ictalurus%20punctatus/
Native range is the Neartic in lower Canada and throughout the Midwest of the United States. It has been widely introduced internationally as well as throughout the U.S. It is found in fresh, brackish and salt water.
Spawning occurs once per year in summer, usually May-July. Optimal egg development is 25-27°C (77-80.6°F).
Conclusion: Highly adaptable to different thermal regimes indicates little difficulty in the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Green sunfish (*Lepomis cyanellus*)
http://animaldiversity.ummz.umich.edu/accounts/Lepomis%20cyanellus/
The native range occurs in central North America, from the plains east of the Rocky Mountains and west of the Appalachian mountains, including north-eastern Mexico and southeastern Canada. It has been introduced and established in a majority of the continental United States, with the exception of Florida and a few northeastern states. It has been introduced internationally as an exotic species. It is widely tolerant of many different aquatic conditions.
Spawning occurs when the water temperature rises above 21°C (70°F). They will spawn up to every 8 to 10 days during the spawning season of May-August.
Conclusion: Wide geographic distribution, wide range of suitable summer spawning temperatures and repeat spawning suggests tolerance of reproduction to temperature fluctuations in the Stony River at Mount Storm. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Blacknose dace (*Rhinichthys atratulus*)
http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-041.pdf
The blacknose dace is distributed from Manitoba to Nebraska, east to the Maritime Provinces, and south along both sides of the Appalachian Mountains to Georgia and Alabama.
Breeding is in May-July at temperatures ranging from 15.6 to 22°C (59-71.6°F). In northern parts of the range spawning begins when temperatures reach 21C (69.8°F).
Conclusion: The wide distribution and broad range of spawning temperatures suggest tolerance of temperature fluctuations in the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

White sucker (*Catostomus commersoni*)
http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-064.pdf
White sucker is found in lacustrine and riverine environments from the Mackenzie River, Hudson Bay drainage, and the Labrador Peninsula; south along the Atlantic Coast to western Georgia; along the northern extremes of the Gulf States to northern Oklahoma; north through the eastern sections of Colorado, Wyoming, and Montana; and through Alberta, north-central British Columbia and southeastern Yukon territory.
White suckers start their upstream spawning migration in spring to early summer, when the daily maximum water temperature reaches 10°C (50°F). The migration continues until

the water temperature reaches about 18°C (64°F). Initiation of spawning migrations appears to be either temperature-dependent and/or stream discharge-dependent. Sudden temperature drops may diminish or stop migration.
Conclusion: The wide distribution and broad range of spawning temperatures suggest tolerance of temperature fluctuations in the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Creek chub (*Semotilus atromaculatus*)
http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-004.pdf
The creek chub is a widely-distributed cyprinid ranging from the Rocky Mountains to the Atlantic Coast and from the Gulf of Mexico to southern Manitoba and Quebec.
Creek chubs spawn in spring (April-July) as water temperatures approach 14°C (57.2°F). Successful reproduction in creek chubs is adversely affected by water temperatures < 11°C (51.8°F)
Conclusion: The wide distribution and intolerance of low temperatures for spawning suggest tolerance of warm temperature additions to the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Fantail darter (*Etheostoma flabellare*)
http://en.wikipedia.org/wiki/Fantail_darter
The fantail darter is distributed across much of eastern North America, from the Great Lakes and the Mississippi River basins to South Carolina and northern Alabama, and as far west as northeastern Oklahoma.
The fish spawn in early summer, when water temperatures reach 17-20°C (62.6-68°F). The fantail darter apparently needs warmer temperature waters than most other darters before it can spawn.
Conclusion: The wide distribution suggests tolerance of temperature fluctuations in the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Northern hogsucker (*Hypentelium nigricans*)
http://en.wikipedia.org/wiki/Northern_hogsucker
Range is Great Lakes, Hudson Bay (Red River), and Mississippi River basins from New York and southern Ontario to Minnesota, and south to northern Alabama, southern Arkansas, and eastern Louisiana; Atlantic Slope drainages from Mohawk-Hudson River, New York, to Altamaha River, northern Georgia; Gulf Slope drainages from Pascagoula River, Mississippi, to Comite River, Louisiana.
Spawning occurs when water temperatures reach about 15°C (59°F), usually in May in much of its range.
Conclusion: The wide distribution suggests tolerance of temperature fluctuations in the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Bluegill (*Lepomis macrochirus*)
http://animaldiversity.ummz.umich.edu/accounts/Lepomis%20macrochirus/
Bluegill range from Quebec to Mexico in lakes and streams in the St. Lawrence, Great Lakes, and Mississippi River basins. The species has been successfully introduced widely internationally.
Spawning generally occurs May-September when water temperature is between 17 and 31°C (62.8-87.8°F), although in the Chesapeake Bay area it can begin spawning at 12°C (53.6°F).
<u>Conclusion:</u> The wide distribution and wide range of spawning temperatures in summer suggest little problem for reproduction in the Stony River. May spawn somewhat earlier than otherwise in generally warmer Stony River.

Largemouth bass (*Micropterus salmoides*)
http://www.flmnh.ufl.edu/fish/Gallery/Descript/LargemouthBass/LargemouthBass.html
Largemouth bass is one of the most widely distributed fishes in the world. The original range is most of the eastern half of the United States, however it is now found in the majority of states, in nearly all freshwater habitats. It is abundant internationally due to its popularity as a sports fish.
Spawning occurs once annually above about 17.8°C (64°F) but optimal spawning temperature is around 18.9-20°C (66-68°F). This occurs between February in the extreme southern end of its U.S. range to July in northern areas.
<u>Conclusion:</u> Because of its populations being adapted to widely varying environments and climatic conditions, it is unlikely that moderate temperature changes in the Stony River will disrupt reproduction. However, it may spawn somewhat earlier than otherwise in generally warmer Stony River. Also, the population in the river downstream of the dam is augmented by fish from the reservoir.